EXTENSION NOTE

forest sciences
NELSON FOREST REGION

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- **With close supervision, and careful consideration for soil conditions, post-harvest skid-road rehabilitation and stumping *may* be successful on sites with sensitive soils.**
- **Timber-harvesting costs can be reduced when skid trails are spaced closer together and then rehabilitated after harvesting.**

Effects of Harvest Season and Root Rot Treatment on Sensitive Soils in the Rocky Mountains: Trial Establishment

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INTRODUCTION

In 1998 the Invermere Forest District, Slocan Forest Products Ltd. (Radium Division), and the Forest Sciences Section of the Nelson Forest Region jointly initiated an operational harvesting trial to examine the effects of season of harvest and stumping treatments on sensitive calcareous soils found in the Rocky Mountain Trench.

The study took place in southeastern British Columbia on two adjacent blocks in the Nine Mile Creek area, east of Canal Flats. The study is part of the Invermere Enhanced Forest Management Pilot Project (EFMPP)[1] and is an extension of the Whitetail Brook project.[2] Random skidding and designated trails are being compared, and, in addition to stumping, *Hypholoma fasiculare*[3] is being examined as a competing agent for Armillaria root rot.

Calcareous soils are considered more sensitive to disturbance by harvesting activities because the disturbance may alter their chemical and physical properties and this may in turn negatively affect tree growth (Kishchuk et al 1999). The presence of fine-textured calcareous soils on this harvesting site would normally have precluded spring harvesting or stumping. Two silviculture systems were tested, including irregular shelterwood (30% residual basal area) and clearcut with reserves.

OBJECTIVES

The objectives of the overall study are to investigate the effects of:

1. Harvesting season (spring versus summer) on soil disturbance.
2. Post-harvest stumping on soil disturbance and Armillaria levels.
3. Rehabilitated skid trails on soil disturbance and tree growth.
4. Root-rot treatments on tree survival and growth.
5. *Hypholoma fasiculare* (sulphur tuft mushroom) on Armillaria root rot.

This Extension Note provides preliminary information about some study outcomes, to assist foresters in developing prescriptions for sites with high levels of root disease, calcareous soils, and resource values that constrain clearcutting. In particular, stumping and skidding options are discussed. More research results will be published as the project progresses.

LOCATION AND SITE DESCRIPTION

The 21-ha study site is located in the Invermere Forest District. The site is 18 km north and east of Canal Flats, below Mount Grainger, at Nine

[1] The goal of the Invermere EFMPP is to develop operational forest management strategies that focus on the timing, location, and intensity of management practices; the application of various harvesting systems; and forest inventory and research activities. Emphasis is placed on the principles of adaptive management.

[2] Whitetail Brook—see Sacenieks and Pinnell 1998.

[3] *Hypholoma fasiculare* (sulphur tuft mushroom) is a common wood decay fungus that is being investigated as a possible control agent for Armillaria root disease. This fungus has been shown to outcompete Armillaria on woody substrates in a variety of situations, and it is easily inoculated into stumps. It is expected that when the Hypholoma is established in stumps, it will compete with the Armillaria for available food and so limit the energy available to Armillaria to establish new infections. A number of trials have been set up in BC; results are pending (Chapman 2000).

Mile Creek which is a tributary of the Kootenay River. The site is on a generally west-facing bench at an elevation of 1325 m in the dry cool Montane Spruce subzone (MSdk; Braumandl and Curran 1992). Slopes are generally less than 30%, with some steeper pitches near the top ends of the blocks. Soils are silt loams to silty clay loams, with unfavourable calcareous subsoils located at depths of 20-22 cm. The mixed species stand consisted of 376 m^3/ha of Douglas-fir, western larch, spruce, and lodgepole pine.

In the 1940s, Douglas-fir and larch were selectively harvested for railway ties from a portion of Block 1 and from approximately 25% of Block 2. Pixel surveys using aboveground indicators found Armillaria in 45% of Block 1 (4.7 ha), and in 12% of Block 2 (16 ha).

TREATMENTS

Two cutblocks were laid out in 1996. Block 1 was split into six treatment units, and Block 2 into eight units (Figures 1 and 2). Units were further subdivided and various treatments were applied, including stumping, or no stumping, mechanical site preparation (MSP) or no MSP, and *Hypholoma fasiculare* or no *Hypholoma fasiculare*, and combinations of each. The stumping treatment was further refined. To minimize damage to reserve trees, and to reduce windthrow after harvesting, stumps <2 m from a reserve tree were not removed. Stumps >2 m from a reserve tree were removed. In addition, half of Block 2 was reserved to conduct a trial of harvesting on wet soil conditions in the spring of 1999, with the above treatments to be applied after that.

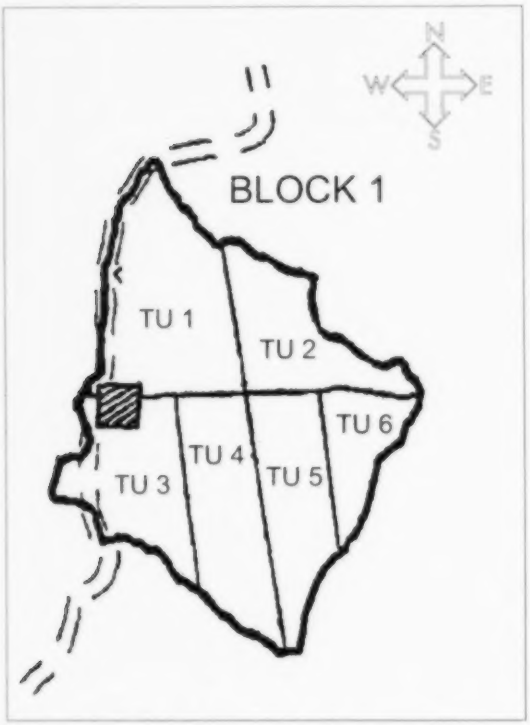

Figure 1. Layout of Block 1. (TU = Treatment Unit)

HARVESTING

Harvesting in dry soil conditions was conducted between September 2 and September 25, 1998. Blocks were conventionally harvested with a six-person crew using one hand faller, two grapple skidders, one line skidder, one feller-buncher, and one processor. A total of 3964 m^3 was harvested, with an average production of 400 m^3/day. Wood piece size and quality were exceptionally good.[4]

Close skid-trail spacing on Block 2 was compared to random skidding on Block 1. Both methods were expected to increase harvesting productivity. However, there were concerns that these short-term economic benefits might be offset by long-term decreased soil productivity caused by the increased soil disturbance associated with both practices. Therefore, the study is also examining if skid trails built on sensitive calcareous soils can be successfully rehabilitated.

The design and layout of Block 2 were good, so skidding distance and some adverse skidding did not affect productivity. During the drier, September harvesting, closer skid-trail spacing meant that forwarding could be done by skidding instead of excavator hoe chucking, thus reducing harvesting costs by \$2.63/m^3. The wetter, spring harvesting occurred from June 15 to July 18, and incorporated hoe forwarding to create wider spaced trails. This allowed a rubber-tired skidder to wrap the mainline around a large turn of logs, thus providing high production and offsetting the hoe costs. Also, changing inter-trail spacing from 35 m to 25 m increased production per skidding machine by an average of 12 m^3/day, and resulted in a daily production of 100 m^3/machine/day. This further reduced harvesting costs by \$1.52/m^3, for a total savings of \$4.63/m^3, before skid-trail rehabilitation, which cost \$0.58/m^3 (see below).[5]

STUMPING

On September 29, 1998 a Caterpillar 200 series excavator, equipped with a 360° rotating clamshell bucket and ripper teeth, completed post-harvest stumping under very dry soil conditions.

The original prescription specified the removal of only those stumps <40 cm in diameter, but the licensee thought that stumps >40 cm could also be removed without creating much extra cost or disturbance. So, each treatment unit was split to compare the effects of removing only stumps <40 cm to those of removing all stumps.

Normally, the Invermere Forest District does not stump stems >40 cm on sensitive soils because they feel it leads to excessive disturbance; stumps >40 cm are difficult to remove because they have deep, well-established tap roots. However, removing these large Douglas-fir stumps is considered critical to managing the inoculum levels of Armillaria because they take the longest time to decay.

It took 3-8 min/stump to remove the larger stumps, not including the time to move the equipment between stumps; smaller stumps were removed in less than 3 min.

[4] S. Pitt, Woods Foreman, Slocan Forest Products Ltd., personal communication, 1998.
[5] S. Pitt, Woods Foreman, Slocan Forest Products Ltd., personal communication, 1998.

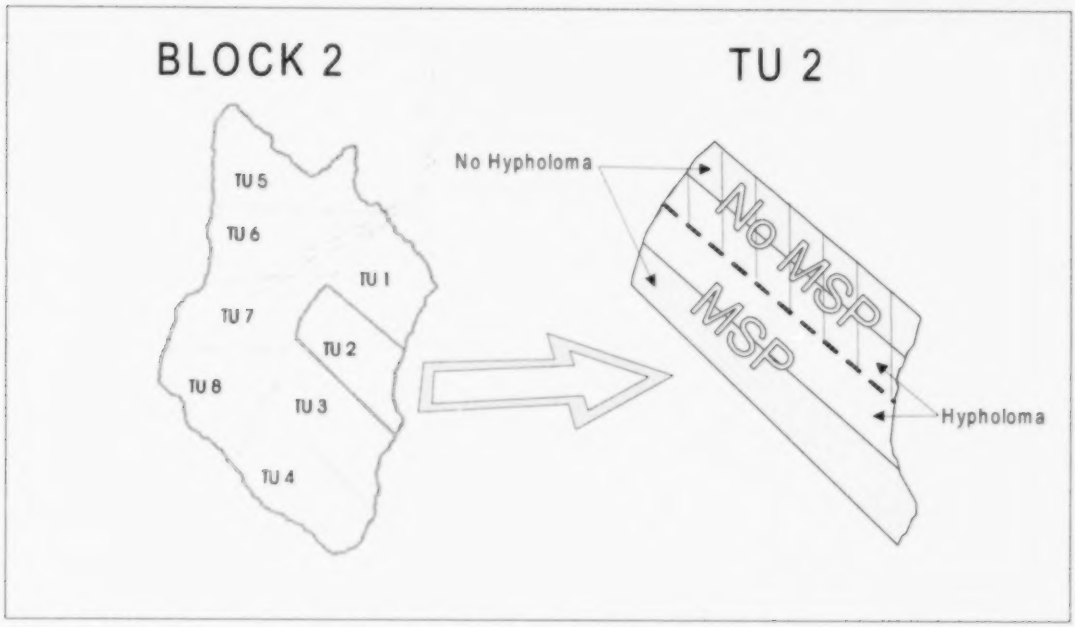

Figure 2. Layout of Block 2. (TU = Treatment Unit. MSP = mechanical site preparation.)

The machine operator used the bucket to break larger roots on either side of stumps >40 cm in diameter. This movement resulted in soil mixing, and loosening of the stump. The clamshell part of the bucket was used to grab the top of the stump, and then to pull the stump straight up out of the ground. Next, the stump was lifted over the stump hole, shaken lightly, and flipped back into the hole, upside down. This minimizes the growing site occupied by the stumps.

Removing only the stump and immediate root collar area caused less soil disturbance than if roots had also been removed. Soil disturbance was minimized because the excavator operator ensured that only minor amounts of calcareous subsoil from the stump hole were deposited over the surrounding area. Further rehabilitation of the stumped site included using the teeth on the bucket to rake the loosened forest floor and soil back into the stump hole.

The total cost of stumping was $9078, or $2.29/m^3, not including extra supervision provided by the BCMOF (see below). Although high, the cost reflects the difficulty in removing the large Douglas-fir stumps. It is hoped that these costs will be justified by reducing the rate of Armillaria, and by improving tree growth in the future stand.

SKID-TRAIL REHABILITATION

It was not necessary to excavate or blade the skid trails, thus cutbanks along the skid trails were minimal to non-existent. Most of the skid trails not needed for wet season harvesting were rehabilitated.

Skid-trail rehabilitation involved "ripping" the trail bed with the 12-cm ripper teeth on the clamshell bucket. These teeth allowed for deeper ripping than the standard 5-cm length. The hoe arm was extended and the bucket teeth were sunk into the soil. Next, the teeth were pulled towards and then away from the machine, avoiding any lifting and mixing which would bring unfavourable subsoils to the surface. Finally, nearby slash was carefully distributed on the trail to mimic the same post-harvest conditions existing next to the skid trail.

The clamshell bucket worked well for trail rehabilitation; the cost was $2300, or $0.58/m^3; costs would be lower for rehabilitating only to below the final soil disturbance limit. Both stumping and skid-trail rehabilitation were closely supervised, at an additional cost of $360/day for 10 days. Seedlings will be planted on both the rehabilitated and non-rehabilitated skid trails to compare tree growth.

SITE DISTURBANCE

One premise of this study was that the soil-disturbance levels in the Silviculture Prescription were planned to temporarily exceed the maximum set by the Forest Practices Code guidelines. This proviso is clarified in the Forest Practices Code General Bulletin 19 (BCMOF 1998), which states that the soil conservation guideline maximum (10%) may be temporarily exceeded provided that it is outlined in the Silviculture Prescription, and that skid trails are rehabilitated in a timely manner. For example, studies of summer skidding disturbance in the Nelson Region demonstrate that 13% disturbance is commonly created during more productive harvesting on less sensitive soils (Curran 1999); on these sites, a Silviculture Prescription allowing up to 15% disturbance during harvesting, but requiring rehabilitation to well below the 10% maximum may be approved, subject to the provisions in General Bulletin 19.

The soil-disturbance levels will be summarized in an upcoming Extension Note.

CONCLUSIONS

1. The clamshell bucket was less effective than a conventional bucket and thumb system would be for stumping. The clamshell turned over stumps easily, but created more soil disturbance than a conventional bucket would. A modified rake or "walrus tusk" attachment, or a bucket with longer teeth (45 cm long), would have been more effective for stumping.

2. The excavator operator was inexperienced at stumping; however, with close supervision, he quickly learned the stumping and skid-trail rehabilitation techniques. Although this initially increased rehabilitation costs, it suggests that, with adequate supervision, these skills can be easily learned by most operators.

3. Reducing the distance between skid trails reduced harvesting costs. However, soil productivity is still considered to be protected because of the follow-up rehabilitation, and the fact that traffic off the trails was minimized, which on sensitive soils can cause significant compaction. This theory will be tested in the long term by measuring tree growth. Closer skid-trail spacing significantly reduces costs (e.g. in terms of time for skidding and cost of equipment) but is offset by the cost of trail rehabilitation. The licensee preferred to reduce forwarding costs by building closely spaced skid trails, and then rehabilitating a portion of those trails to meet soil-disturbance limits.

4. Skid-trail rehabilitation appears economically feasible and it seems to protect the soil. However, tree growth on these calcareous trails needs to be proven and is part of the on-going study.

5. Generally, stumping causes less soil disturbance than pushover harvesting. Stumping spreads less calcareous subsoil over the forest floor (Norris et al 1998).

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